

CLAIMS

1. A method of electronically adjusting an image to compensate for laser beam process direction position errors in an electrophotographic apparatus comprising:

5           reading image data from a first memory location, said image data comprising pixels arranged in a plurality of columns and a plurality of rows;

performing pixel shifts on select columns of said image data based upon a bow profile that characterizes process direction position errors of Pels written by a laser beam as it traverses generally in a scan direction, to define adjusted image data;

10           storing said adjusted image data to a second memory location; and

deriving a laser signal from said adjusted image data in said second memory location.

2. The method according to claim 1, wherein said first and said second memory locations comprise first and second areas of a main system memory.

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3. The method according to claim 1, wherein said second memory location stores said adjusted image data for less than the entirety of said image.

4. The method according to claim 1, further comprising:

20           organizing said image data into a plurality of bands, each band comprising a predetermined number of columns and a predetermined number of rows of pixels of said image data, wherein pixel shifts are performed on select columns of each band based upon said bow profile and said plurality of bands are processed one band at a time.

25           5. The method according to claim 4, wherein said second memory location is dimensioned to store at least two bands of adjusted image data.

6. The method according to claim 5, wherein a first band of adjusted image data is processed from said second memory location for deriving said laser signal while pixel shifts are performed on said image data according to said bow profile such that a second band of adjusted image data is stored in said second memory location.

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7. The method according to claim 6, wherein processing of said first band of adjusted image data to derive said laser signal must be complete before storing a third band of adjusted image data into said second memory location.

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8. The method according to claim 4, wherein said second memory location comprises a destination buffer and an overflow buffer, wherein performing pixel shifts comprises:  
performing pixel shifts according to said bow profile on a select band;  
storing the results in said destination buffer; and  
storing pixels that were shifted out of said select band into said overflow buffer.

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9. The method according to claim 8, wherein said laser signal is derived from a select of said overflow and destination buffers.

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10. The method according to claim 8, further comprising an output buffer that contains the contents of a select one of said destination and overflow buffers after processing a previous band, wherein said laser signal is derived from said output buffer.

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11. The method according to claim 10, wherein as each band is processed, the previous band from said destination buffer becomes the new data for said output buffer and the data in said overflow buffer is incorporated into the next destination buffer.

12. The method according to claim 10, wherein as each band is processed, the previous band from the overflow buffer becomes the new data for said output buffer and the previous output of said destination buffer becomes the new data for said overflow buffer.
- 5      13. The method according to claim 10, wherein said destination, overflow and output buffers are each identified by a pointer to a unique area of said second memory location and as each new band of image data is processed, said pointers circularly rotate so that each buffer serves as the destination, overflow and output buffer for every third band that is processed.
- 10     14. The method according to claim 1, wherein said bow profile comprises an instruction for each column of said image data indicating whether that column should be shifted up, down, or not shifted.
- 15     15. The method according to claim 14, further comprising constraining said instructions according to rules that limit the number of process direction shifts that can be corrected.
16. The method according to claim 14, wherein said instructions define each shift up or down within a column as a relative offset with respect to an adjacent column position.
- 20     17. The method according to claim 14, wherein each column includes a one-bit instruction that describes whether the bow processor should perform a relative pixel shift.
18. The method according to claim 17, wherein said instructions are constrained to limit the maximum amplitude of pixel shifts allowable in said bow profile.
- 25     19. The method according to claim 1, wherein said pixel shifts are performed from the top to the bottom of said image.

20. The method according to claim 1, wherein said pixel shifts are performed from the bottom to the top of said image.

21. A system for electronically adjusting image data to compensate for laser beam process direction position errors in an electrophotographic device comprising:

5           a first memory location for storing image data;

              a second memory location for storing adjusted image data;

10           a printhead operable to emit a laser beam across a scan path, said laser beam exhibiting process direction position errors; and

              a bow processor operatively configured to obtain said image data from said first memory location, apply pixels shifts on select columns of said image based upon a bow profile that characterizes said laser beam process direction position errors of Pels written by said laser beam to define adjusted image data, and store said adjusted image data in said second memory location; and

15           a video processor operatively configured to derive a laser signal suitable for processing by said printhead based upon said adjusted image data from said second memory location.

22. The system according to claim 21, wherein said image data is transferred to said bow processor and said bow processor writes said adjusted image data to said second memory location 20 using direct memory access transactions.

23. The system according to claim 21, further comprising a third memory location, wherein said bow profile is stored in said third location as a plurality of instructions that describe the process direction shifts for corresponding Pel positions along said scan path required to compensate for 25 said laser beam process direction position errors.

24. The system according to claim 21, wherein said bow processor is implemented in an application specific integrated circuit.

25. The system according to claim 21, further comprising a queue accessible by said bow processor for temporarily storing and prioritizing sections of said image data prior to said bow processor applying said pixel shifts to said image.

5           26. The system according to claim 21, wherein said electrophotographic device comprises a color device, and said bow processor performs pixel shifts for each of the cyan, yellow, magenta and black image planes.

10           27. The system according to claim 21, wherein said second memory location includes a destination buffer, an overflow buffer and an output buffer, and wherein said system further comprising at least one control buffer in data communication with said bow processor that points to the location in said second memory of said destination, overflow and output buffers.

15           28. The system according to claim 21, further comprising a microprocessor operatively configured to derive said pixel shift instructions based upon data stored on said printhead.

20           29. A method for electronically altering image data to compensate for laser beam process direction position errors in an electrophotographic device comprising:

              storing said image data to be printed in memory;

              dividing said image data up into a plurality of sections; and

              for each of said plurality of sections of said image data:

25           selectively performing process direction shifts of image data in said section according to a bow profile that characterizes process direction position errors of Pels written by a laser beam as it traverses generally in a scan direction, to define adjusted image data for that section of said image data;

              storing said adjusted image data in a destination buffer;

capturing adjusted image data shifted out of said section in an overflow buffer; and  
outputting said adjusted image data to a printhead.

30. A method of encoding a look ahead feature into bow instructions for performing process  
direction position adjustments on image data in an electrophotographic device comprising:  
5 defining a bow profile having a plurality of adjacent column positions;  
encoding into each column position, a value that indicates whether a process direction shift  
should occur in said image data; and  
for each column position where a shift occurs, encoding a value that indicates a shift  
10 direction in the next adjacent column location.

31. The method according to claim 30, wherein each shift comprises a jump of one row of image  
data in the process direction with relative to an adjacent column position.

15 32. The method according to claim 30, wherein each column position is associated with a  
predetermined location along a corresponding laser beam scan path and is represented by a one-bit  
value.

20 33. The method according to claim 32, wherein shifts are encoded by identifying whether a  
change in direction should occur relative to a previously determined direction.

34. The method according to claim 32, further comprising applying process direction position  
shifts to said image data comprising:  
25 reading across each row of image data;  
identifying a corresponding column in said bow profile for each print element of said  
image data being considered; and  
if said corresponding column indicates a shift:  
reading the next adjacent column in said bow profile;

determining a direction for said shift based upon a value stored in the next adjacent column; and

performing a process direction shift of at least one print element of said image data in said direction; and

5 if said corresponding column indicates no shift:

positioning a corresponding print element of said image data in the same row as the most previously placed print element of said image data.

35. The method according to claim 30, wherein said bow profile is encoded part of an instruction.

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36. The method according to claim 35, wherein each instruction further encodes a current shift direction.

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37. The method according to claim 35, further comprising dividing said bow profile into a plurality of strips wherein each strip encoded into a unique instruction.

38. The method according to claim 37, further comprising encoding a look ahead into each instruction comprising:

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if the last column position of a bow profile strip in a first instruction indicates a process direction shift:

encoding a look ahead bit in the corresponding instruction with a value corresponding to the direction of the shift; and

clearing the value of the first column of the corresponding bow profile strip in the next instruction.